

Glycogen Synthesis (Glucose Storage)

Branched glucan (α -(1-4) and (α -(1-6) bonds) formed from glucose and stored as spherical granules (10-40 nm in diameter)

- Promoted by insulin

a. Linear glycogen chain synthesis – formation of G6P from glucose

Glucose

ATP \downarrow *Glucokinase*

Glucose-6-phosphate (G6P) + ADP

b. Linear glycogen chain synthesis – formation of G1P from G6P

Glucose-6-phosphate (G6P)

\downarrow *Phosphoglucomutase*

Glucose-1-phosphate (G1P)

c. Linear glycogen chain synthesis – formation of UDP

Glucose-1-phosphate (G1P)

Uridine triphosphate (UTP) \downarrow *UDP-glucose pyrophosphorylase*

Uridine diphosphate glucose (UDPG) + PP_i

d. Linear glycogen chain synthesis – formation of linear chains

UDPG

Glycogen_n \downarrow *Glycogen synthetase*

Glycogen_{n+1} + UDP

e. Introduction of α -(1-6) glycogen branches

Linear Glycogen

\downarrow *Branching enzyme*

Branches and hence branched glycogen

Figure 1 (part 1). Glucose metabolism

Glycogen Hydrolysis and Glucose Formation

- Promoted by adrenaline (especially muscle)
- Promoted by glucagon (especially liver)

f. Linear glycogen chain hydrolysis

Linear α -(1-4) Glycogen Residues

$+P_i \downarrow$ *Glycogen phosphorylase*

Glycogen_{n-1} + Glucose -1-phosphate (G1P)
[glucose cleaved from non-reducing end]

g. Conversion of G1P to G6P

Glucose-1-phosphate (G1P)

\downarrow *Phosphoglucomutase*

Glucose-6-phosphate (G6P)

h. Conversion of G6P to glucose

Glucose-6-phosphate (G6P)

\downarrow *Glucose-6-phosphatase*

Glucose + P_i

i. Glycogen branch point hydrolysis

Branched α -(1-6) Glycogen Residues

\downarrow *Transferase/ debranching enzyme*

Linear Glycogen from transferase activity from α -(1-6) bond

+

Glucose from branch residue (debranching/glucosidase activity)

Note: Blood glucose is maintained at about $\sim 4.5 \text{ mmol l}^{-1}$ in man.

Figure 1 (part 2). Glucose metabolism

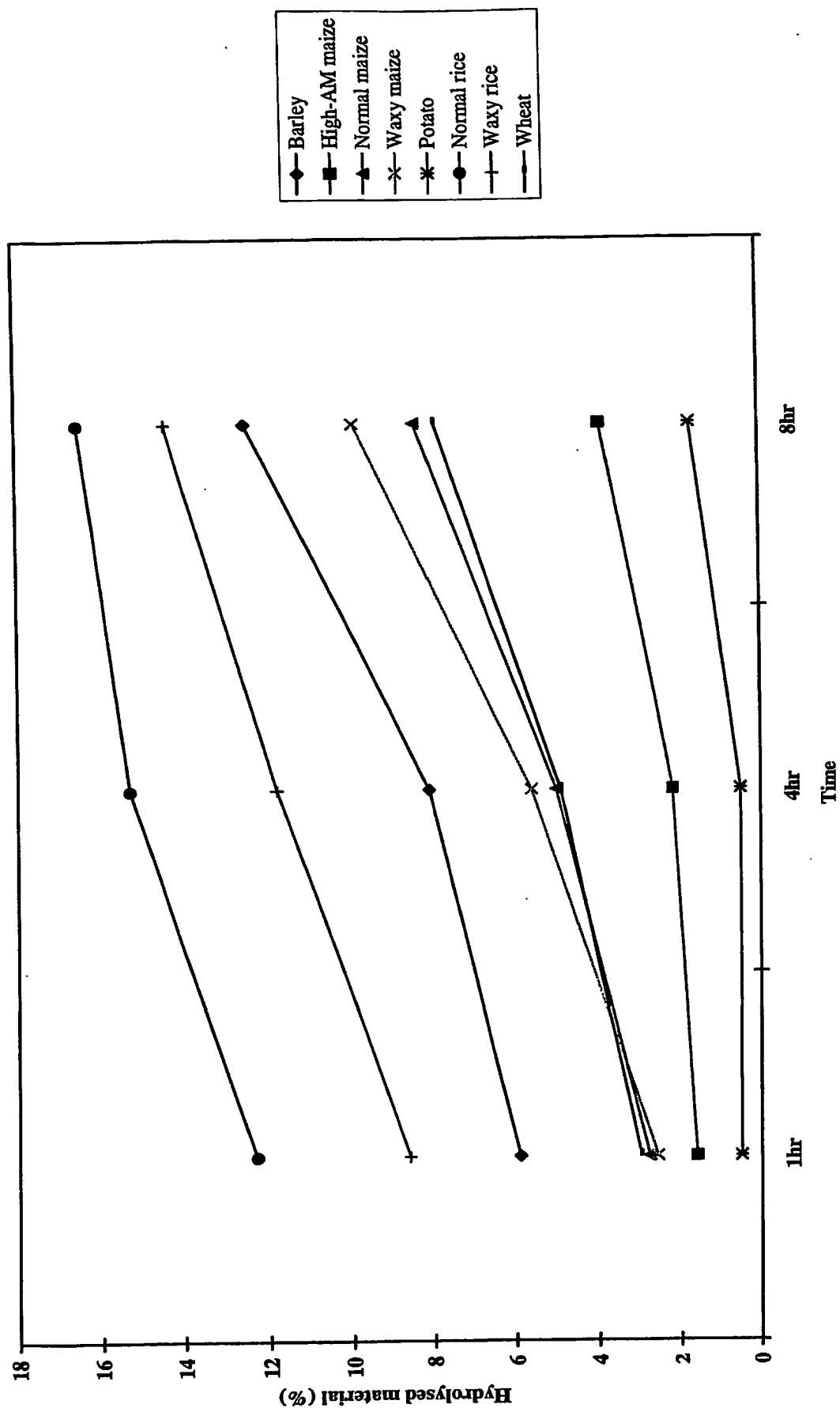


Figure 2: Comparison of the hydrolysis profile of native starches using the Karkalas *et al* (1992) procedure.

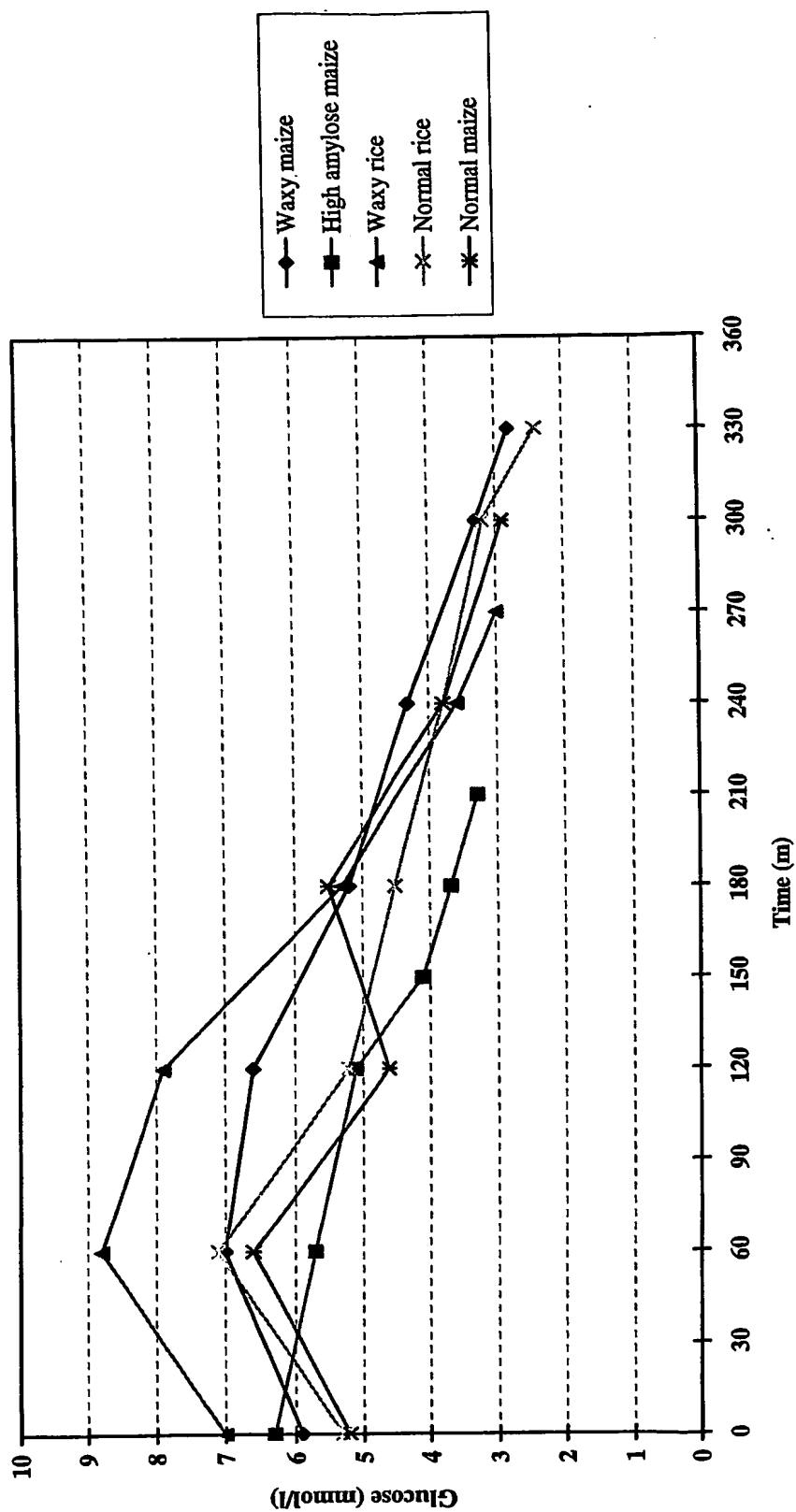


Figure 3: Blood glucose level after consumption of native starches

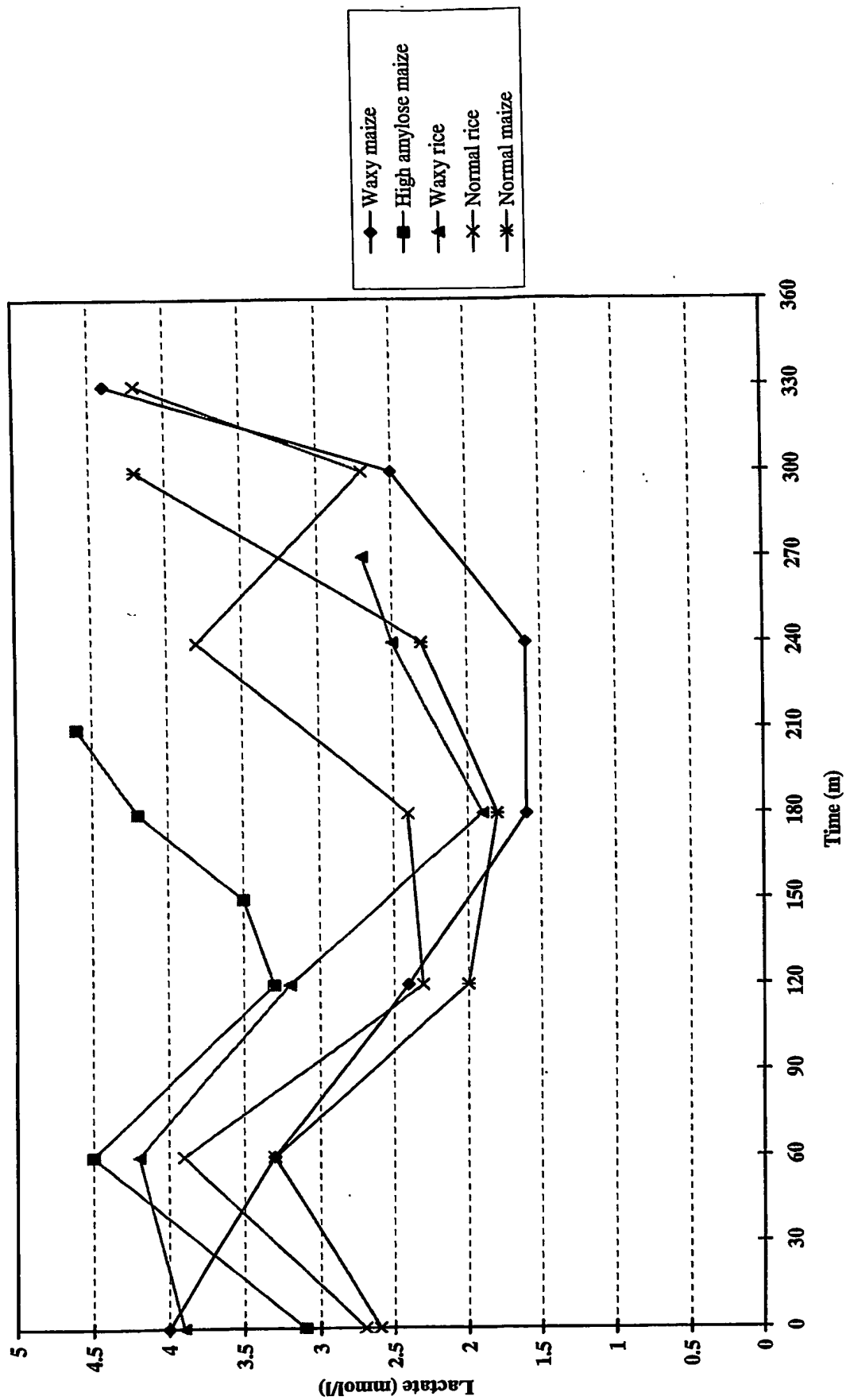


Figure 4: Comparison of the blood lactate level after consumption of native starches

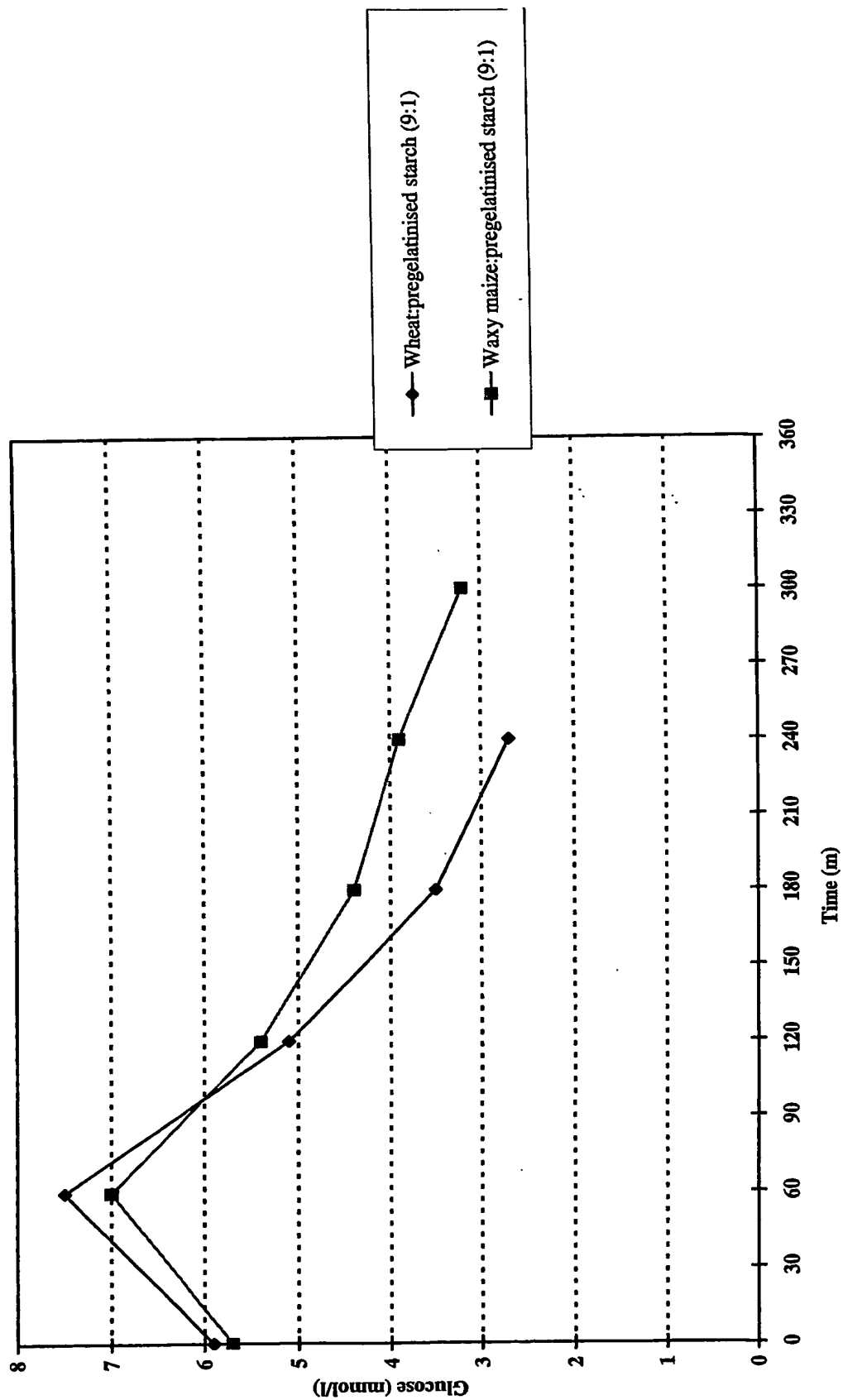


Figure 5: Comparison of blood glucose after consumption of two native starches (wheat and waxy maize) with added pregelatinised (maize) starch.

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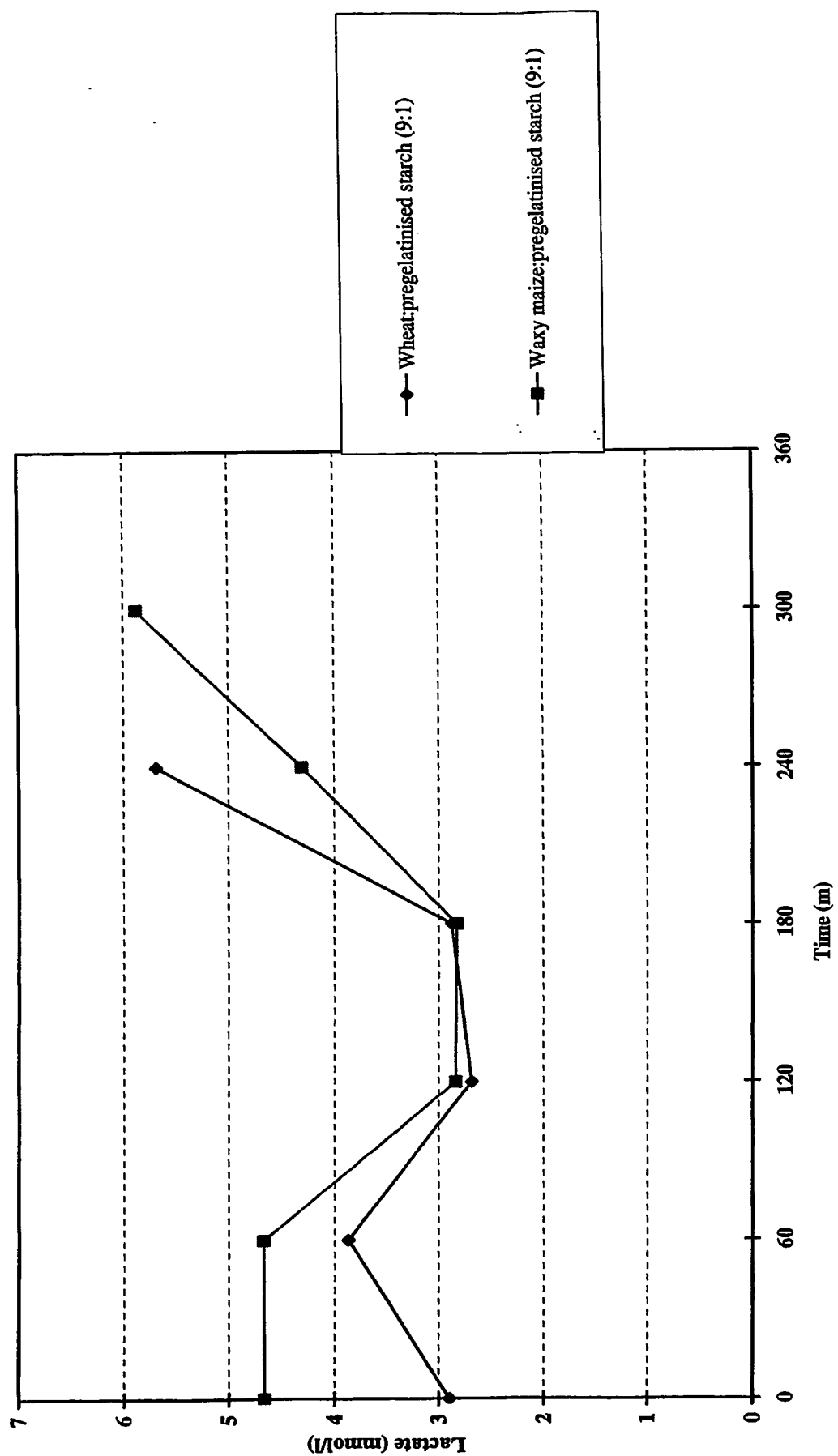


Figure 6: Comparison of the blood lactate level after consumption of two native starches (wheat and waxy maize) with added pregelatinised (maize) starch

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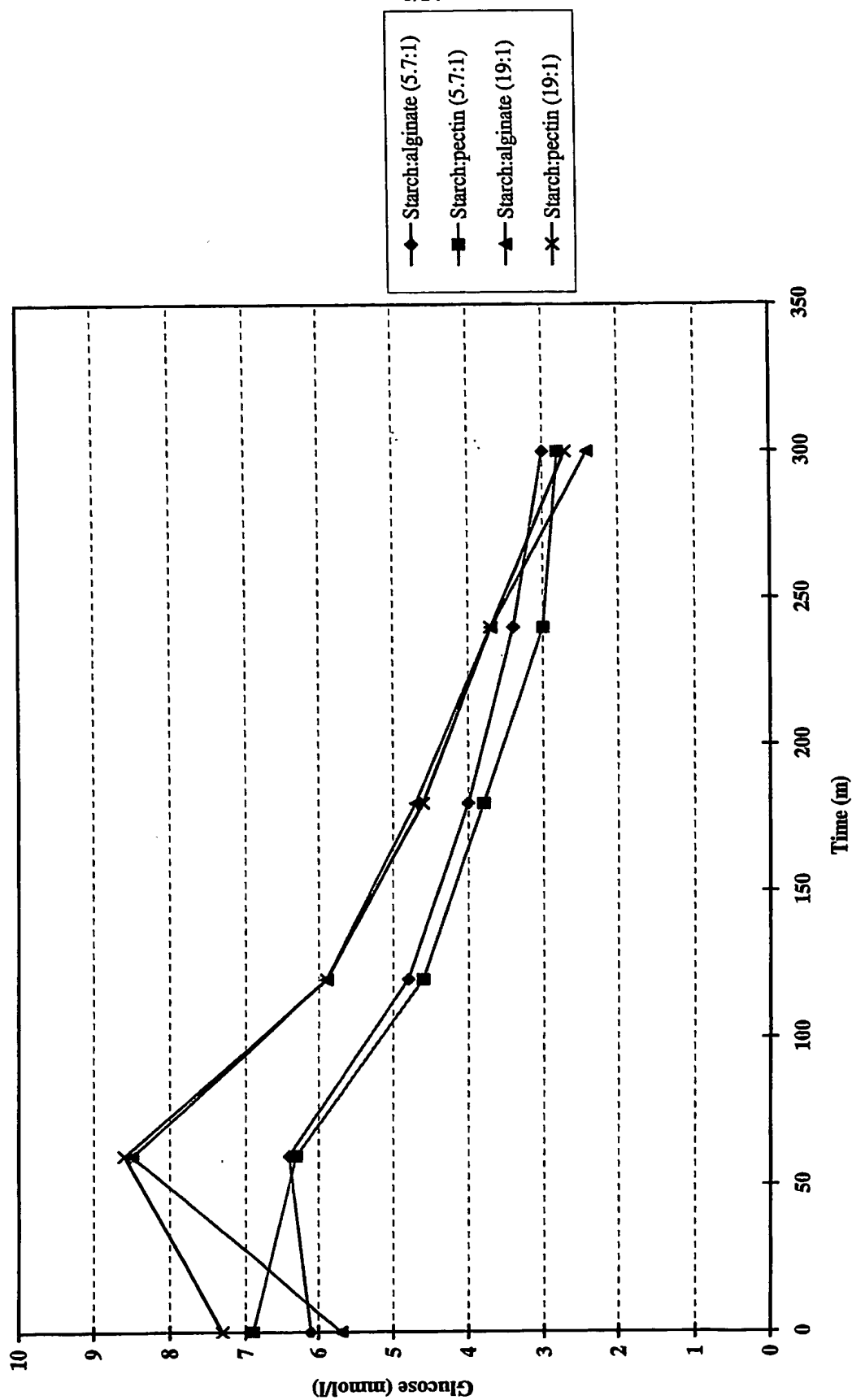


Figure 7: Comparison of blood glucose after consumption starch (native waxy maize and soluble) encapsulated with pectin or alginate.

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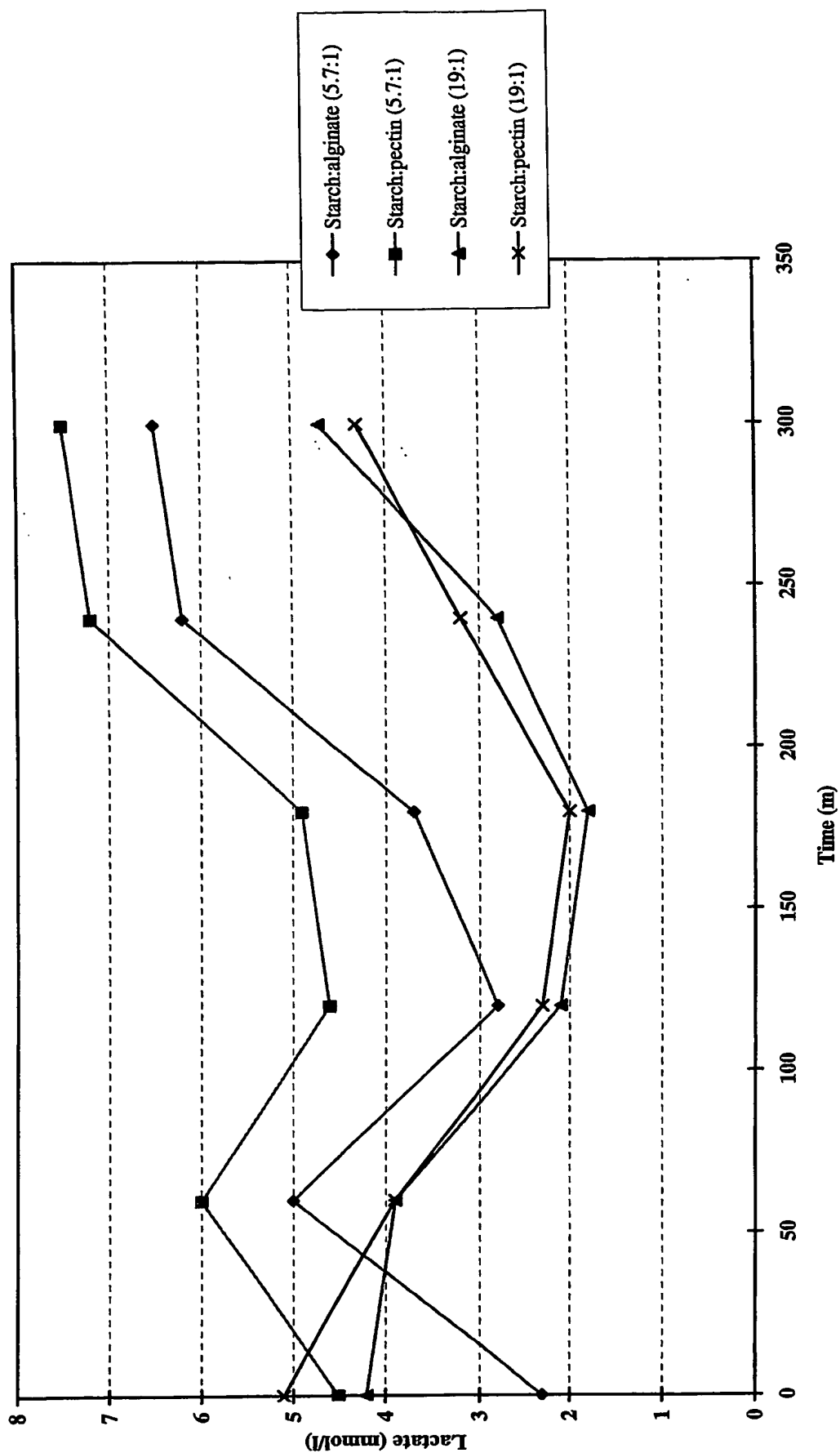


Figure 8: Comparison of blood lactate after consumption of starch (native waxy maize and soluble) encapsulated with pectin or alginate

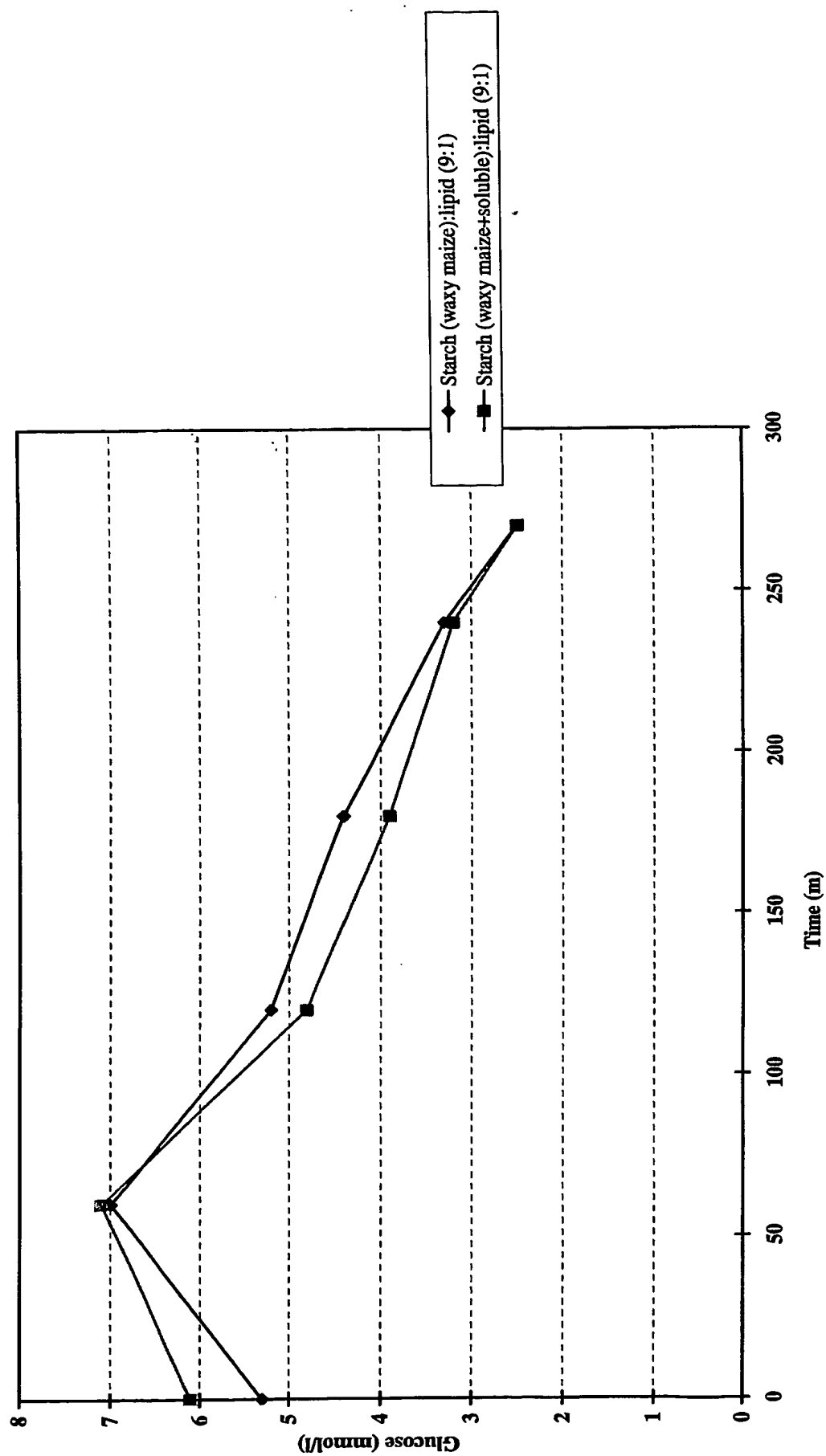


Figure 9: Comparison of blood glucose after consumption of starch (native waxy maize, soluble) encapsulated with lipid

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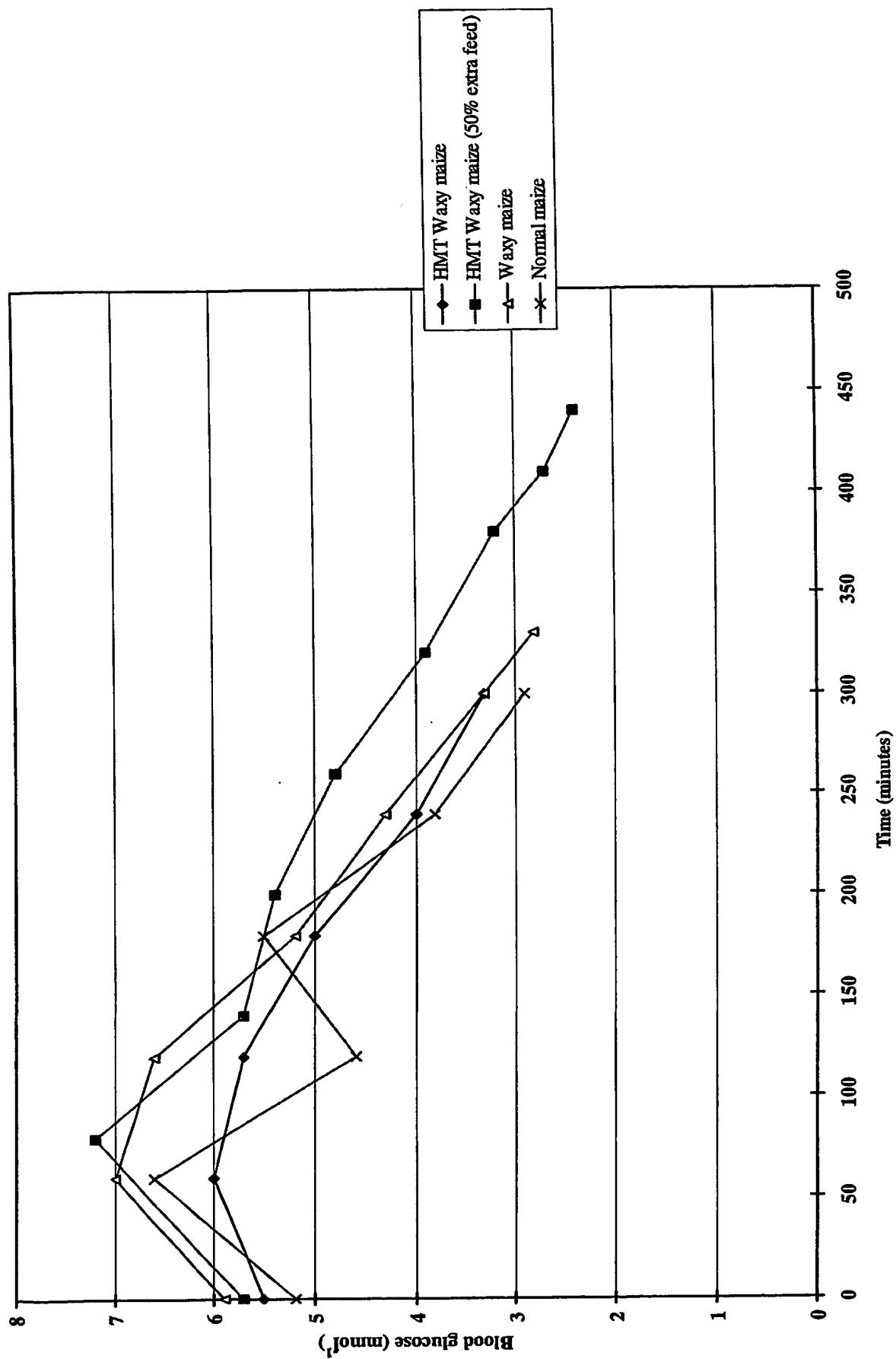


Figure 10: Comparison of blood glucose after consumption of heat-moisture treated waxy maize starch, waxy maize and normal maize starch.

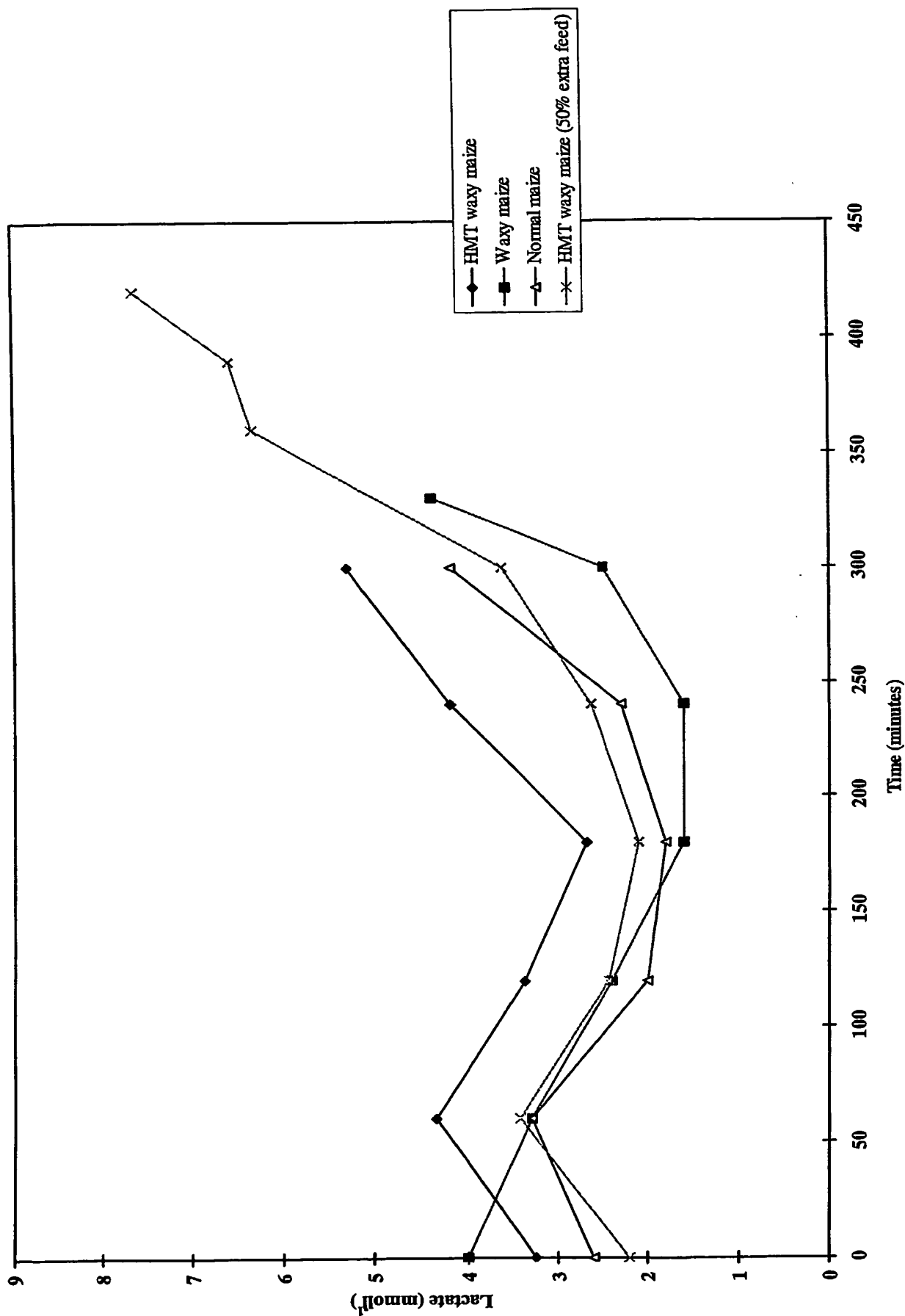


Figure 11: Comparison of blood lactate after consumption of waxy maize, normal maize and heat-moisture treated waxy maize starches.

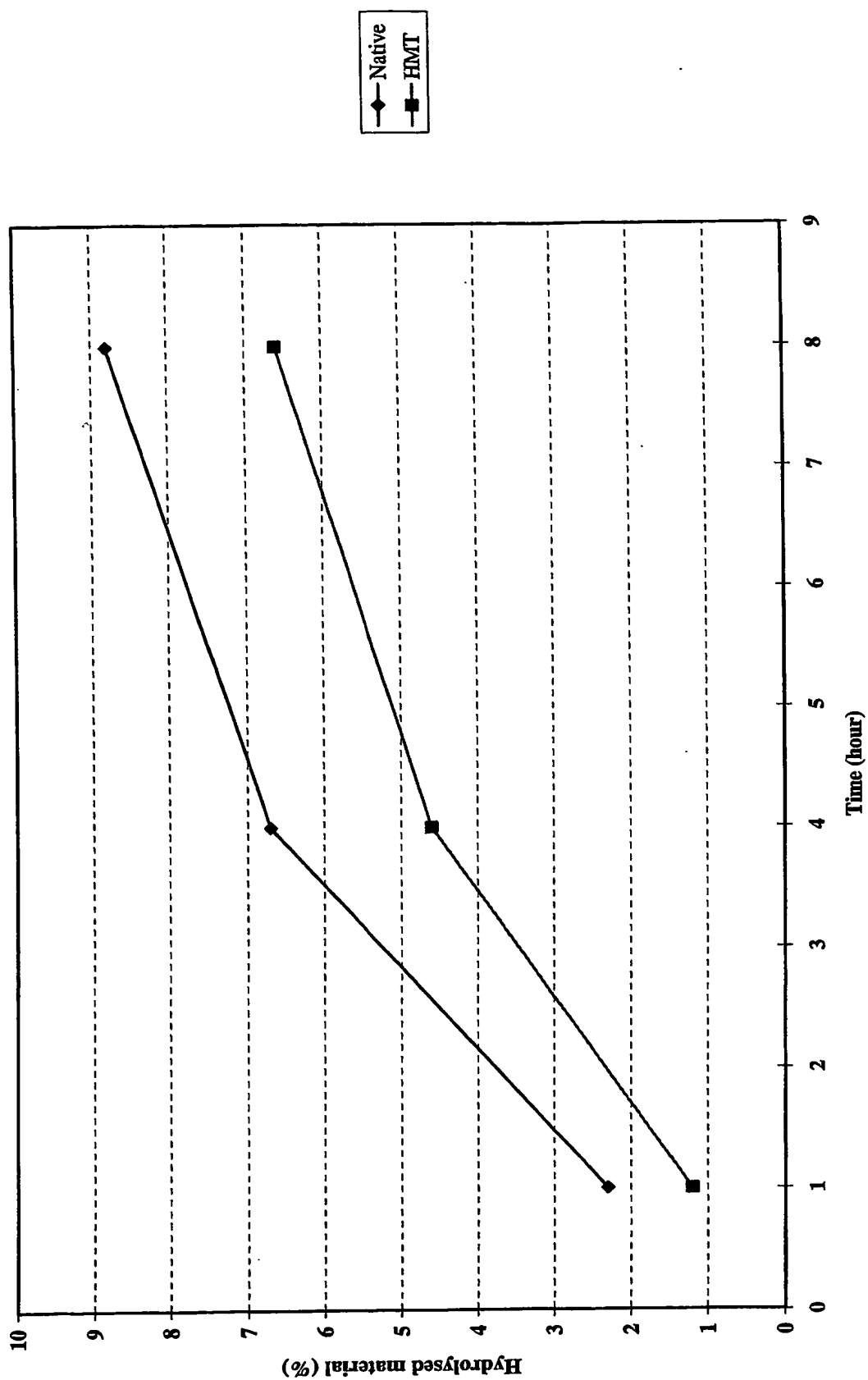


Figure 12: Comparison of digestibility of native and heat-moisture treated waxy maize starches

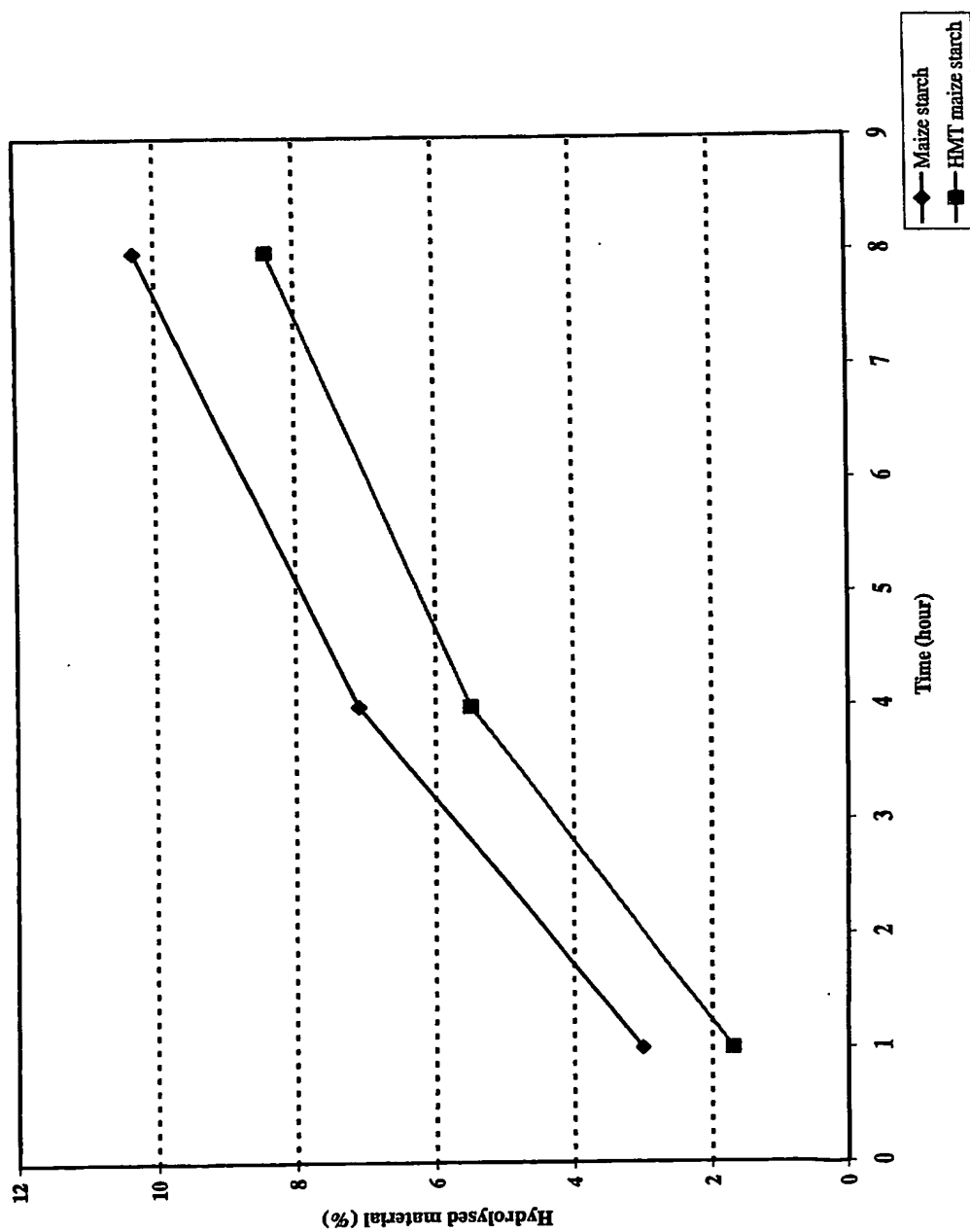


Figure 13: Comparison of digestibility of native and heat-moisture treated maize starches